



The molten salt reactor (MSR) in generation IV: Overview and perspectives



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ABSTRACT

Molten Salt Reactors (MSR) with the fuel dissolved in the liquid salt and fluoride-salt-cooled High-temperature Reactors (FHR) have many research themes in common. This paper gives an overview of the international R&D efforts on these reactor types carried out in the framework of Generation-IV. Many countries worldwide contribute to this reactor technology, among which the European Union, France, Japan, Russia and the USA, and for the past few years China and India have also contributed. In general, the international R&D focuses on three main lines of research. The USA focuses on the FHR, which will be a nearer-term application of liquid salt as a reactor coolant, while China also focuses on solid fuel reactors as a precursor to molten salt reactors with liquid fuel and a thermal neutron spectrum. The EU, France and Russia are focusing on the development of a fast spectrum molten salt reactor capable of either breeding or transmutation of actinides from spent nuclear fuel.

Future research topics focus on liquid salt technology and materials behavior, the fuel and fuel cycle chemistry and modeling, and the numerical simulation and safety design aspects of the reactor. MSR development attracts more and more attention every year, because it is generally considered as most sustainable of the six Generation-IV designs with intrinsic safety features. Continuing joint efforts are needed to advance common molten salt reactor technologies.

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Abbreviations: CR, Conversion Ratio; EFPY, Equivalent Full Power Year; ISTC, International Science and Technical Centre, Moscow, Russia; IGC, Intergranular Cracking; LWR, Light Water Reactor; MA, Minor Actinides; MARS, Minor Actinides Recycling in Salts, Rosatom R&D project, 2010–2013, Russia; MOSART, Molten Salt Actinide Recycler Transforming system, developed at KI, Russia; MOX, Mixed Oxide fuel; MSBR, Molten Salt Breeder Reactor, developed in ORNL, USA; MSFR, Molten Salt Fast Reactor, developed in CNRS, France; MSR, Molten Salt Reactor; MSRE, Molten Salt Reactor Experiment, developed in ORNL, USA; REE, Rare Earth Elements; RW, Radioactive Waste; SNF, Spent Nuclear Fuel; TRU, Transuranic Elements; ORNL, Oak Ridge National Laboratory, USA; UOX, Uranium Oxide fuel.

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